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Outline of a Method for Evaluation of Behavioral Changes of Workers under Alternating Day-and-Night Shift System

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ABSTRACT: A test method developed by the author for evaluation of psychological and social affects of alternating day-and-night work schedule disclosed the development of new patterns in the behavioral aspects such as "living-tempo" and "time-language" that the subjects were little aware of. The results suggest that this method has sufficient validity as it allows observation of inherent behavioral characteristics while weakening defensive reaction, which conventional methods for psychological evaluation unavoidably encountered.

Key words: Alternating Day-and-Night Work Schedule, Rating Method, "Living-tempo", "Time-language", Defensive Reaction, Behavioral Characteristics.

INTRODUCTION

It has been pointed out that alternating day-and-night work schedule not affects the biological rhythm of workers but also causes various behavioral problems due to discordance in time between the workers' personal schedule and the activity of the general society¹⁻⁴. Depending on the intervals between shifts and the time of daily shifts occupy, the work schedule may be staggered over the normal 7-day week, as a result, the workers are restricted in participation in normal activity cycles of the society. Social occasions with the family, friends, or neighbors, for example, may often have to be

sacrificed⁴⁻⁶.

Life under such restrictions has been considered to generate continuous "tension" to repress cultural and social desires, as a result, induce mental regression or develop negative attitudes⁷⁻⁹.

However, these changes in behavior have hardly been definitively demonstrated due primarily to the inability of conventional methods for psychological evaluation to adequately characterize the behavioral changes that reflect psychological effects of the irregular work schedule^{7,9}.

To detect and define this inherent "tension" associated with such a work schedule, a new evaluation method was devised first on the basis of the author's original idea of psychological framework¹⁰, and then the validity of the method was examined on the

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assumption that the true behavioral characteristics are manifested in "Living-tempo" and "Time-language", of which the workers are barely conscious¹¹⁾.

EVALUATION METHOD¹⁰⁾

Definition:

Analyses were performed on the basis of the Role-theory¹²⁻¹⁴⁾ and Field-theory¹⁵⁻¹⁷⁾, assuming that "tension" is derived from distortion in role playing.

As a result, the behavioral pattern of an individual was considered to be a socialized form of the self through the daily role relationship, and conflict or tension due to the disharmony between the self and the others can be alleviated only by adjustment of the role relationship.

This relationship may, moreover, be gradually isolated from the external environment and eventually be internalized by dynamic readjustment.

As for the structural-functional system, it was assumed that there is the boundary (dynamic) region, according to the field-theory, between the inner personal region and the external environment, and that interaction between the inner personal region and the external environment is possible only through this boundary region.

Framework:

Diagrammatically, the above hypothesis may be shown as two triangles inversely superimposed (Fig.1). One large triangle represents emotional behavior as a function of cognitive behavior through which communication with the external environment becomes possible, and the other volitional behavior as a function of memory behavior.

If the relationship between the inner personal region and the external environment (life space) becomes unstable, the emotional and volitional behavior interact in the boundary region, and induce expressive actions to determine the individuality of the expressive actions. These expressive actions are directed externally in the forms of bodily or verbal expression.

The attitude or personality of an individual is considered to be reflected in these expressions, and may be evaluated objectively by applying the concept of "Distinguished Path"¹⁰⁾.

Dependent Variables:

"Living-tempo"¹⁸⁻²⁰⁾ and "Time-language"^{12,13,21)} were selected as dependent variables of emotional and volitional behavior, and "Life-consciousness"^{22,23)} and "(Time) Sustaining Valuation"²⁴⁻²⁶⁾ as those of cognitive

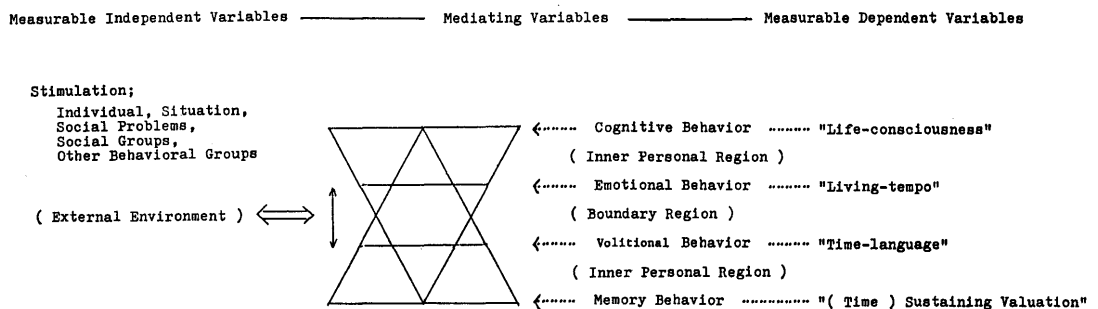


Figure 1: Psychological Framework

and memory behavior. As a result, 300 items under 73 subcategories were selected for inquiries as below.

Life-consciousness (120 items 20 subcategories under 4 major categories)

Material System; Food and Clothes, Housing, Possession, Income and Expenditure Planning, Type of Property

Social System; Relationship with Neighbors, Relationship within Family, Relationship in Work Environment, Evaluation of Occupation, Political Responsibility

Cultural System; Religious and Ceremonial Event, Family Customs, Attitudes, Public Ethics, Contribution to Society

Environmental Framework; Use of Facilities, Range of Activities, Material Level of Life, Residential Environment, Rest

Living-tempo (120 items of 20 subcategories under 4 major categories)

Sensory and Motor Activities; Gait, Writing Style, Manual Dexterity, Ascending and Descending of Stairs, Dressing

Intelligence; Familiarity, Sensitivity, Memory, Reproduction, Foresight

Emotionality; Nervousness, Passion, Tension, Patience, Regularity

Social Relationship; Harmony in Family, Harmony with Friends, Adaptation to Society, Consultation, Cooperativeness

Time-language (28 items of 17 subcategories under 4 major categories)

Time Anticipation; Going out, Term of Borrowing, Suitable Age for Marriage, Sleep, Holidays, Free Time

Ordering; Previously → Latter, Other Day → Some Day, Past Years → Years to Come, Short While Ago → Soon, Former

→ Promising, Past → Future

Response to Occasions; Good Morning, Good Afternoon, Good Evening

Behavioral Requirements; Participation in Leisure Activities, Meeting People on Appointments, Attendance at Meetings

(Time) Sustaining Valuation (32 items of 16 subcategories under 4 major categories)

Stimulation Frequency Effects; **[200 Stim. /min. for 30 sec.], [40 Stim./min. for 30 sec.], [200 Stim. /min. for 30 sec. - 40 Stim./min. for 30 sec. - 200 Stim. /min. for 30 sec.], [40 Stim./min. for 30 sec. - 200 Stim./min. for 30 sec. - 40 Stim./min. for 30 sec.]**

Systematization Effects; **[Simple Sounds (30 sec.) - Coupling of Rel. Words (30 sec.)], [Simple Sounds (30 sec.) - Coupling of Unrel. Words (30 sec.)], [Simple Sounds (30 sec.) - Rorschach Test I²⁷ (30 sec.)], [Simple Sounds (30 sec.) - Rorschach Test IX (30 sec.)]**

Order Effects; **[Simple Sounds (30 sec.) - Complex Sounds (30 sec.)], [Complex Sounds (30 sec.) - Simple Sounds (30 sec.)], [Simple Sounds (30 sec.) - Complex Sounds (30 sec.)], [Complex Sounds (30 sec.) - Simple Sounds (30 sec.)]**

Recoding Effects; **[Coded Fig. (30 sec.) - Complex Sounds (30 sec.) - Test Fig. (30 sec.)], [Complex Fig. (30 sec.) - Complex Sounds (30 sec.) - Test Fig. (30 sec.)], [Rorschach Test with Response Positive Words (30 sec.) - Complex Sounds (30 sec.) - Rorschach Test X (30 sec.)], [Rorschach Test with Response Negative Words (30 sec.) - Complex Sounds (30 sec.) - Rorschach Test X (30 sec.)]**

"Life-consciousness", "Living-tempo", and "Time-language" were studied by a questionnaire, and "(Time) Sustaining Valuation" by experiments. The questionnaire was answered according to a 5-Grade Scale, and the results of the experiments on "(Time) Sustaining Valuation" were expressed in terms of a Magnitude Estimate Scale between two conditions.

VALIDITY OF EVALUATION METHOD¹¹⁾

Subjects and Methods:

Twenty surveys were conducted at companies during a 2-week period on 189 healthy males from two different industrial districts who had been engaged continuously in the steel industry under an alternating day-and-night shift system.

Validity of Samples:

The mean age (35.4 years) of the subjects and the mean number of years (17.1

years) in the present occupation showed a correlation with a correlation coefficient (r) of 0.761 (Fig. 2).

Since there were no significant differences in the distribution pattern of the gross scores for each examination item between the workers of the two districts, it was considered to be appropriate to treat the entire subjects as one group for analysis. The sample size (189) fulfilled the requirement (20-50 or more than 100)²⁸⁾ of this study.

These results also showed that the present method sufficiently tolerates variation among groups.

Validity of Examination Method:

The mean score of the questionnaire showed a normal distribution pattern, and that of the experiment of "(Time) Sustaining Valuation" was positive.

The scores were $2.62 < \bar{x} < 3.03$ for "Life-consciousness", $2.52 < \bar{x} < 3.11$ for "Living-

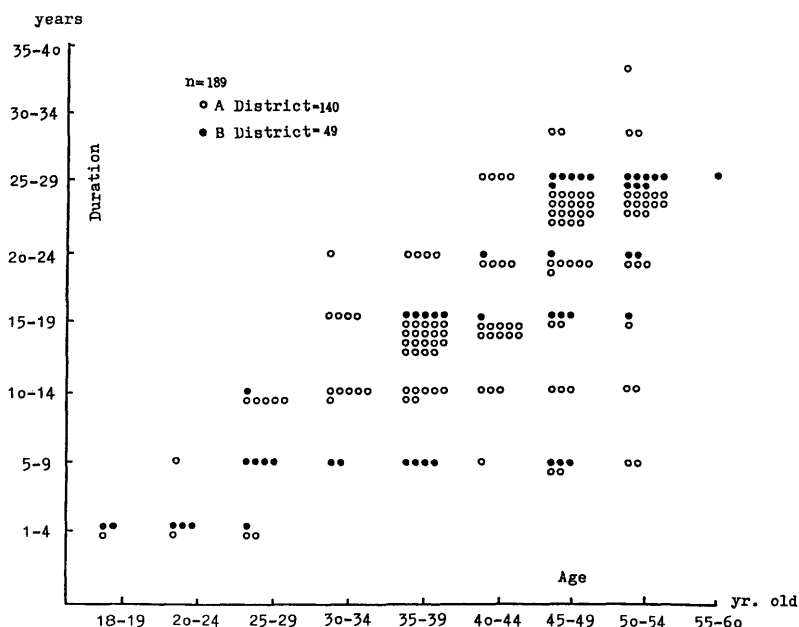


Figure 2: Duration of Employment Under Alternating Shift Schedule for Different Districts and Age Groups ($r=0.761$)

Table 1 : Simple Correlation Matrix of Examination Items, Age, and Duration of Employment Under Alternating Shift Schedule

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Age																		
2. Duration of Shiftwork	** 0.761																	
3. Material System	** -0.254	** -0.180																
4. Social System	** -0.294	** -0.277	** 0.430															
5. Cultural System	** -0.234	** -0.204	** 0.469	** 0.656														
6. Environmental Framework	** -0.310	** -0.303	** 0.540	** 0.586	** 0.626													
7. Sensory and Motor Activities	0.056	0.027	** 0.260	** 0.224	** 0.293	** 0.253												
8. Intelligence	** 0.159	0.064	0.050	** 0.164	** 0.243	** 0.104	** 0.496											
9. Emotionality	-0.048	-0.012	** 0.169	* 0.130	** 0.245	* 0.159	** 0.335	** 0.394										
10. Social Relationship	-0.083	-0.153	** 0.168	** 0.329	** 0.368	** 0.247	** 0.393	** 0.323	** 0.475									
11. Time Anticipation	-0.050	-0.047	-0.008	0.021	0.059	0.018	** 0.154	-0.055	0.066	0.106								
12. Ordering	** 0.178	* 0.129	0.026	-0.028	-0.086	-0.120	* -0.039	0.014	0.018	-0.049	0.106							
13. Responses to Occasions	-0.107	-0.022	0.030	-0.005	-0.020	-0.035	0.001	* -0.132	* -0.123	-0.084	-0.028	0.039						
14. Behavioral Requirements	** -0.188	* -0.147	** 0.167	** 0.045	** 0.175	-0.012	* 0.139	0.027	** 0.157	0.056	** 0.171	0.011	0.135					
15. Stimulation Frequency Effects	0.043	0.038	-0.052	-0.021	0.015	-0.017	0.030	-0.016	0.013	-0.062	0.040	-0.078	0.048	-0.126				
16. Systematization Effects	0.049	-0.032	0.108	** 0.181	** 0.200	0.066	0.014	0.029	0.114	0.129	0.030	0.001	0.070	-0.022	0.028			
17. Order Effects	0.060	0.036	0.026	-0.126	* -0.255	-0.148	0.028	0.042	0.001	0.042	-0.038	0.015	0.071	0.040	0.075	0.028		
18. Recording Effects	0.047	-0.012	0.110	0.135	* 0.119	0.100	0.103	-0.011	-0.072	0.034	-0.042	** -0.296	0.030	-0.053	0.098	-0.014	-0.007	

**p<0.01 *p<0.05

Table 2: Partial Correlation Matrix of Examination Items When The Age (top) and Duration of Under Alternating Shift Schedule (bottom) are Uniform

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Age	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2. Duration of Shiftwork	—	—	0.021	-0.086	-0.041	-0.108	-0.023	-0.088	0.037	-0.138*	-0.014	-0.010	0.092	0.005	0.008	-0.107	-0.014	-0.073
3. Material System	-0.183**	—	—	0.384**	0.435**	0.501**	0.283**	0.094	0.161**	0.152**	-0.021	0.075	0.002	0.123*	-0.042	0.124*	0.042	0.125*
4. Social System	-0.132*	—	0.402**	—	0.631**	0.544**	0.251**	0.222**	0.121*	0.319**	0.006	0.025	-0.038	-0.014	-0.008	0.204**	-0.093	0.155*
5. Cultural System	-0.123*	—	0.448**	0.637**	—	0.599**	0.315**	0.291**	0.240**	0.360**	0.048	-0.045	-0.047	0.134*	0.025	0.217**	-0.042	0.133*
6. Environmental Framework	-0.129*	—	0.517**	0.548**	0.604**	—	0.285**	0.163**	0.152**	0.234**	0.003	-0.069	-0.072	-0.079	-0.004	0.086	-0.136*	0.121*
7. Sensory and Motor Activities	0.053	—	0.269**	0.241**	0.304**	0.274**	—	0.494**	0.339**	0.399**	0.157**	-0.050	0.007	0.153**	0.027	0.011	0.025	0.101
8. Intelligence	0.170**	—	0.062	0.189**	0.261**	0.131*	0.495**	—	0.407**	0.341**	-0.047	-0.014	-0.117	0.060	-0.023	0.022	0.033	-0.019
9. Emotionality	-0.060	—	0.169**	0.131*	0.247**	0.163**	0.335**	0.395**	—	0.476**	0.064	0.027	-0.129*	0.150**	0.015	0.116	0.004	-0.070
10. Social Relationship	0.052	—	0.144*	0.301**	0.348**	0.213**	0.402**	0.337**	0.482**	—	0.102	-0.035	-0.094	0.041	-0.058	0.134*	0.047	0.037
11. Time Anticipation	-0.021	—	-0.016	0.008	0.005	0.004	0.156**	-0.052	0.062	0.100	—	0.117	-0.034	0.164**	0.042	0.006	-0.035	-0.039
12. Ordering	0.124*	—	0.050	0.008	-0.060	-0.085	-0.043	0.005	0.020	-0.030	0.114	—	0.059	0.048	-0.087	-0.007	0.004	-0.310**
13. Responses to Occasions	-0.139*	—	0.026	-0.011	-0.025	-0.044	0.001	-0.131*	-0.123*	-0.089	-0.029	0.042	—	0.117	0.053	0.076	0.078	0.035
14. Behavioral Requirements	-0.134*	—	0.144*	0.004	0.149*	-0.060	0.145*	0.038	0.157**	0.035	0.166**	0.030	0.134*	—	-0.120*	-0.012	0.053	-0.045
15. Stimulation Frequency Effects	0.021	—	-0.045	-0.010	0.023	-0.006	0.029	-0.189**	0.014	-0.057	0.042	-0.084	0.049	-0.122*	—	-0.030	0.072	0.092
16. Systematization Effects	0.113	—	0.103	0.179**	0.197**	0.059	0.015	0.031	0.114	0.126*	0.002	0.005	0.070	-0.127*	-0.027	—	0.025	-0.016
17. Order Effects	0.049	—	0.033	-0.100	-0.048	-0.144*	0.027	0.040	0.001	0.048	-0.036	0.010	0.072	0.046	0.073	0.029	—	-0.010
18. Recording Effects	0.085	—	0.109	0.137*	0.118	0.102	0.104	-0.010	-0.072	0.032	-0.042	-0.297**	0.032	-0.055	0.095	-0.014	-0.007	—

**P<0.01 *P<0.05

tempo”, $2.45 < \bar{x} < 3.16$ for “Time-language”, and $1.70 < \bar{x} < 5.30$ for “(Time) Sustaining Valuation”.

There was no variation in answers among the items either by the questionnaire method or by the experimental method, but individual variation was present ($p < 0.05$). Defensive Reaction was weak.

From these results, the item examined and differentiation of individuals by the present method were considered to be valid.

Examination Items, Age and Duration of Employment Under the Alternating Shift System:

As shown in Table 1, “Life-consciousness” (3-6) and Age (1) showed a significant correlation ($p < 0.01$), suggesting a better

adjustment in older subjects concerning «Material(3), Social(4), Cultural(5)» and «Environmental Framework(6)» than in younger subjects.

These results were in close agreement with those of the conventional studies in which the age was used as an external standard²⁹⁻³²), thus supporting the validity of this method.

Relationships Among Items:

As shown in Table 2, significant correlations ($p < 0.01$) were observed among all items of “Life-consciousness” (3-6) items.

The results were consistent with the assumption of this study that “Living-tempo” is a poorly conscious aspect of behaviour and is a potential of “Life-consciousness”.

Table 3: Unrotated Factor Loadings (Pattern)

	I	II	III	IV	h^2
Age	-0.328	0.525	-0.283	-0.141	0.640
Life-consciousness					
Material System	0.637	-0.287	0.116	0.005	0.774
Social System	0.745	-0.288	-0.048	-0.178	0.805
Cultural System	0.815	-0.173	-0.020	-0.055	0.798
Environmental Framework	0.739	-0.352	-0.089	-0.192	0.771
Living-tempo					
Sensory and Motor Activities	0.561	0.459	-0.075	0.250	0.710
Intelligence	0.417	0.642	-0.175	-0.027	0.655
Emotionality	0.491	0.521	0.104	0.025	0.710
Social Relationship	0.603	0.384	-0.011	0.020	0.769
Time-language					
Time Anticipation	0.108	0.116	0.389	0.201	0.404
Ordering	-0.114	0.233	0.524	-0.351	0.407
Responses to Occasions	-0.049	-0.254	0.235	0.489	0.461
Behavioral Requirements	0.214	0.000	0.574	0.459	0.457
(Time) Sustaining Valuation					
Stimulation Frequency Effects	-0.039	0.002	-0.353	0.338	0.358
Systematization Effects	0.216	0.012	0.021	-0.131	0.542
Order Effects	-0.070	0.185	0.017	0.456	0.462
Recording Effects	0.149	-0.201	-0.594	0.360	0.505
Eigenvalue	3.519	1.844	1.440	1.238	8.041
Contribution Rate (%)	0.207	0.108	0.085	0.073	0.473

Table 4 Rotated Factor Loadings (Pattern)

	I	II	III	IV
Age	-0.528	0.265	-0.001	-0.366
Life-consciousness				
Material System	0.680	0.104	0.020	0.169
Social System	0.800	0.161	0.040	-0.062
Cultural System	0.773	0.303	0.077	0.047
Environmental Framework	0.830	0.107	0.075	-0.095
Living-tempo				
Sensory and Motor Activities	0.166	0.717	0.162	0.163
Intelligence	0.006	0.772	0.020	-0.140
Emotinality	0.132	0.693	-0.130	0.096
Social Relationship	0.291	0.652	-0.010	0.041
Time-language				
Time Anticipation	0.004	0.138	-0.186	0.403
Ordering	-0.117	0.051	-0.669	0.041
Responses to Occasions	-0.001	-0.215	0.169	0.536
Behavioral Requirements	0.106	0.106	-0.138	0.737
(Time) Sustaining Valuation				
Stimulation Frequency Effects	-0.121	0.042	0.473	0.024
Systematization Effects	0.200	0.115	-0.083	-0.063
Order Effects	-0.250	0.153	0.225	0.333
Recording Effects	0.124	0.001	0.723	-0.078
Eigenvalue	2.955	2.344	1.391	1.351

“Time-language” was less consistent than “Living-tempo”.

Structure of Factors:

The factors could be classified into 4 groups with a Cumulative Contribution Rate of 47.3% (Table 3 and 4). Although the third and fourth groups lacked consistency, the first group was identified as “Life-consciousness” factors of cognition component based on life experience since it was largely dependent on Age. The second was found to

be “Living-tempo” factors of Emotional Components such as speed, strength, agitation and continuation related to Natural Efflux Speed. Thus, the “Life-consciousness” and “Living-tempo” factors were independent of each other.

This supports the consistency of the groups observed in Table 1.

This consistency indicates the validity of the selection of items and their composition in this survey. As for “Time-language” and “(Time) Sustaining Valuation” factors, «Beha-

Table 5: Correlation and Partial Correlation According to Age

	18-29 yr. old		30-39 yr. old		40-49 yr. old		50-55 yr. old	
	Simple R.	Partial R.	Simple R.	Partial R.	Simple R.	Partial R.	Simple R.	Partial R.
Life-consciousness	r =	p =	r =	p =	r =	p =	r =	p =
Material System	0.053	-0.163	0.066	0.023	-0.011	0.038	0.238	0.244
Social System	-0.062	0.072	-0.040	0.041	0.149	0.146	0.187	0.189
Cultural System	-0.007	0.084	-0.031	-0.017	**	**	**	**
Environmental Framework	-0.218	-0.101	-0.111	-0.131	0.368	0.365	0.348	0.349
Living-tempo					0.102	0.144	0.310	0.315
Sensory and Motor Activities	-0.042	0.087	0.008	0.022	0.188	0.190	0.062	0.062
Intelligence	-0.075	0.268	0.104	0.122	0.233	**	**	*
Emotionality	0.529	**	0.054	0.003	0.189	0.139	0.360	0.349
Social Relationship	-0.313	-0.293	0.293	0.284	0.197	*	0.084	0.084
Time-language							0.249	0.250
Time Anticipation	-0.144	-0.190	* -0.288	* -0.258	0.050	0.081	*	*
Ordering	-0.142	0.021	0.155	0.129	-0.161	-0.158	0.419	0.422
Responses to Occasions	0.024	-0.204	-0.170	-0.191	0.002	-0.072	0.002	0.008
Behavioral Requirements	0.019	-0.082	-0.098	-0.075	0.060	0.019	-0.129	-0.130
(Time) Sustaining Valuation							-0.045	-0.046
Stimulation Frequency Effects	-0.158	0.248	-0.184	-0.227	0.109	0.116	0.285	0.285
Systematization Effects	0.289	0.258	0.009	0.041	-0.013	0.020	0.204	0.210
Order Effects	-0.315	-0.306	-0.077	0.003	-0.029	-0.034	-0.032	-0.032
Recording Effects	0.022	0.076	-0.235	-0.214	-0.109	-0.111	*	*
Correlation of frequency distribution according to age	** 0.829 (n=25)		** 0.437 (n=57)		** 0.367 (n=71)		0.003 (n=36)	

**p<0.01 *p<0.05

Table 6: Correlation and Partial Correlation According to the Duration of Employment Under Alternating Shift System

	1-9 years		10-19 years		20 or more years	
	Simple R.	Partial R.	Simple R.	Partial R.	Simple R.	Partial R.
Life-consciousness	r =	p =	r =	p =	r =	p =
Material System	-0.214	0.093	0.083	0.171	-0.015	-0.003
Social System	-0.228	-0.121	-0.036	0.023	-0.008	0.019
Cultural System	-0.162	-0.161	-0.096	-0.040	0.116	0.160
Environmental Framework	-0.194	-0.204	-0.073	-0.001	0.016	0.049
Living-tempo						
Sensory and Motor Activities	-0.081	0.149	0.066	0.035	0.105	-0.030
Intelligence	0.310	-0.158	0.084	0.031	0.167	0.100
Emotionality	0.124	0.003	-0.142	-0.036	-0.063	-0.089
Social Relationship	-0.018	-0.277	-0.177	-0.173	0.056	0.001
Time-language						
Time Anticipation	0.003	-0.100	-0.023	0.009	-0.001	-0.015
Ordering	0.264	-0.199	0.268	0.245	0.027	0.045
Responses to Occasions	-0.257	-0.330	-0.050	-0.078	-0.084	0.044
Behavioral Requirements	0.006	-0.045	0.022	0.119	-0.098	-0.039
(Time) Sustaining Valuation						
Stimulation Frequency Effects	0.032	0.017	-0.098	-0.106	0.022	0.021
Systematization Effects	0.320	0.133	0.034	0.036	-0.133	-0.172
Order Effects	-0.144	-0.015	0.053	0.024	-0.117	-0.228
Recording Effects	0.037	-0.042	0.070	0.017	0.045	-0.001
Correlation of frequency distribution according to the duration of employment	0.532 (n=38)	**	0.320 (n=73)	**	0.519 (n=78)	**

**p<0.01 *p<0.05

vioral Requirements》 and 《Recording Effects》 showed high factor dependency, and these factors were also considered to be appropriate for this method.

On this basis, "Life-consciousness" and "Living-tempo" factors were considered to be consistent with the potential theory derived from the assumption of this study, and "Living-tempo" was considered to be a practical index while relieve from the defensive reaction of workers on alternating shift schedule. The validity of "Time-language", however, could not be ascertained.

SELECTION OF ITEMS TO INCREASE INDEPENDENCY OF THE TEST (DO- UBLE CROSS VALIDATION)

Analysis of Correlation and Partial Correlation According to Age:

Age was found to be highly correlated with 《Emotionality》, 《Social Relationship》 and 《Intelligence》 among "Living-tempo" items by analysis of items with use of the age as the external standard (Table 5).

This suggests that "Living-tempo" is a useful index in evaluating serial changes using age as the external criterion, and that the above three items should be selected for analysis excluding 《Sensory and Motor Activities》.

Analysis of Correlation and Partial Correlation According to the Duration of Employ- ment Under Alternating Shift System:

Analysis of items using the duration of employment under the alternating shift system showed remarkable correlations with 《Responses to Occasions》 and 《Ordering》 among "Time-language" items (Table 6).

Thus, the above two factors as well as

《Behavioral Requirement》 appeared to be appropriate indexes for evaluation of serial effect of the shift system according to the duration of employment.

These results show that "Living-tempo" and "Time-language" are accurate indexes of the psychological effects of alternating day-and-night shift and are useful also for evaluation of inherent serial effects when age and duration of employment were used as external standard to increase independency of the test by the present method.

DISCUSSION

There was a close relationship between "Living-tempo" and "Life-consciousness". This finding suggests that "Living-tempo" is determined by motives such as dilemma and resistance derived from "Life-consciousness" as the prototype and consolidated by the environment, especially, external restrictions.

It further allowed speculation that workers are clearly aware of "Life-consciousness" through the characteristics of changes or absence of the reactions while they cannot be conscious of "Living-tempo" without introspective attitude. The value of "Time-language" as an index was difficult to demonstrate though it did not mean the conventional concept of time. Some insights could be gained, however, in the behavioral pattern that emerges in the optimal situation.

According to Gestalt Theory of Guillaume³³, "Life-consciousness" and "Living-tempo" as subjective or emotional attitude and "(Time) Sustaining Valuation" and "Time-language" as objective or analytical attitude are polarized, and then integrated again through their interaction and by adaptation mechanisms, leading to manifesta-

tion of attitude.

This interaction may be explained by the concept of Distinguished Path¹⁰⁾ which allows communication with the external environment via "Living-tempo" and "Time-language".

In conventional studies, behavioral characteristics of workers under alternating shift schedule have been discussed in relation to innate emotional factors such as the Stereotype (Bast)⁷⁾ and Infantile Discontent (Blakelock)³⁴⁾, but these studies had a common weakness in that they lacked analysis of the relationship of behavioral characteristics with Defensive Reaction suggested in this study.

With this regard Mishima³⁵⁾ demonstrated that "Living-tempo" is a useful parameter in his study on regional differences in physical and mental development of children. He further clarified relationship of "Living-tempo" with Koffka's Executive Organs³⁶⁾ from the viewpoint that it is individualized postnatally, and thus, showed that the behavioral pattern under given conditions is observed in physical expressions. Hall³⁷⁾ and Moore³⁸⁾ investigated the relationship between language and community events or standard time, and considered that Verbal Expressions can determine the process of socialization. Fraisse²¹⁾, Halbwachs³⁹⁾, and piaget⁴⁰⁾ also showed that interest in society determines the memory process consisting of recognition, retention, and recollection.

Therefore, "Living-tempo", and possibly also "Time-language" are considered to be dependent on postnatal influences as are physical and Verbal Expressions and formed in response to individual motives to be adapted to a given environment.

From these findings, "Living-tempo" and

"Time-language" are considered to be behavioral patterns that we are hardly conscious of as in the case of the Distinguished Path of Lewin¹⁷⁾ and Superficial Characteristics of Cattell²⁰⁾ and to be formed under observable developmental influence. These parameters may be used effectively in behavioral study of workers under alternating shift schedule if their advantage of being daily practices hardly recognized by the workers themselves is understood. It is important to further improve this method so that it may be applied to studies in which Defensive Reactions are not intended.

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